

**Office of Food Safety and Shellfish Programs  
2001 Annual Inventory:**

**Commercial & Recreational Shellfish  
Areas of Washington State**

June 2002



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# Contents

INTRODUCTION .....	1
DEFINITIONS AND PROCESS FOR CLASSIFYING COMMERCIAL SHELLFISH GROWING AREAS .....	2
Definitions .....	2
Process .....	3
Shoreline Survey .....	3
STATUS OF COMMERCIAL SHELLFISH GROWING AREAS .....	4
Threatened Shellfish Growing Areas .....	5
Fecal Coliform Status and Trends in Commercial Shellfish Beds .....	11
Closure Zone Determinations .....	15
SHELLFISH GROWING AREA RESTORATION PROGRAM .....	16
Restoration Projects .....	16
PUGET SOUND AMBIENT MONITORING PROGRAM .....	18
LICENSING AND CERTIFICATION PROGRAM .....	18
Washington State Shellfish Industry .....	19
TRIBAL SHELLFISH SANITATION PROGRAM .....	20
VIBRIO PARAHAEMOLYTICUS IN WASHINGTON STATE .....	21
Vibrio Illnesses .....	22
MARINE BIOTOXIN MONITORING PROGRAM .....	23
Paralytic Shellfish Poison .....	23
2001 PSP Summary .....	24
Domoic Acid .....	26
2001 Domoic Acid Summary .....	29
Summary of PSP Status for PSAMP .....	30
RECREATIONAL SHELLFISH PROGRAM .....	33
Consolidated Contracts .....	33
High Risk Harvesters .....	33
Beach Classifications .....	33
Web Site Improvements .....	34

## **INTRODUCTION**

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This is the thirteenth edition of the *Annual Inventory of Commercial and Recreational Shellfish Areas of Washington State*. Formerly titled the *Annual Inventory of Commercial and Recreational Shellfish Areas of Puget Sound*, the name was amended this year to more accurately reflect the scope of this document, which includes Washington's coastal waters as well as those of the Puget Sound. This publication is produced by the Washington State Department of Health, Office of Food Safety and Shellfish Programs (DOH), provides important health information about shellfish resources in Washington's marine waters, and contributes to the fulfillment of the Puget Sound Water Quality Management Plan.

The Puget Sound Water Quality Management Plan, administered by the Puget Sound Water Quality Action Team, is the state's strategy for protecting Puget Sound's health — its water quality and its biological resources. DOH participates with many other agencies to carry out the plan.

In previous years we published 12 county maps inside this publication. Last year we produced a poster size map of the state's shellfish growing areas, and have done so again this year. The map includes features such as commercial growing area classifications, major streams, sewage treatment plant outfalls and recreational shellfish beach classifications. Comments or suggestions are welcome for future editions. Map information is available in electronic GIS format.

Please contact Jan Jacobs at (360) 236-3316 with any comments or requests for this publication. An electronic copy of this publication can be found on the Internet at [www.doh.wa.gov/ehp/sf/pubs](http://www.doh.wa.gov/ehp/sf/pubs).

## DEFINITIONS AND PROCESS FOR CLASSIFYING COMMERCIAL SHELLFISH GROWING AREAS

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DOH classifies all commercial shellfish growing areas in Washington State as Approved, Conditionally Approved, Restricted, or Prohibited. These classifications have specific standards associated with them, which are derived from the *National Shellfish Sanitation Program Model Ordinance* (Chapter IV, 1999 Revision).

### Definitions

#### APPROVED AREAS

This classification authorizes the growing and harvesting of shellfish for direct marketing. DOH may classify a growing area as Approved when pollution source evaluations and the bacteriological water quality data show that fecal material, pathogenic microorganisms, and poisonous or deleterious substances are not present in dangerous concentrations.

The bacteriological quality of the marine water samples collected from an Approved growing area must satisfy both parts of the following standard:

- 1) The concentration of fecal coliform bacteria, the indicator organisms, shall not exceed a geometric mean of 14 per 100 milliliters (ml); and
- 2) The estimated 90th percentile cannot exceed 43 organisms per 100 ml if sampling under the systematic random

scheme. If sampling where point sources of pollution may impact the growing area, not more than 10 percent of the samples can exceed 43 organisms per 100 ml.

A minimum of thirty samples is used for these calculations with the laboratory using the A-1 modified, 5-tube/3-dilution method to estimate the most probable number of fecal coliform bacteria.

Even if the Approved criteria are met for fecal coliform bacteria, DOH may classify a growing area as Conditionally Approved, Restricted, or Prohibited (see definitions below) if pollution source investigations show that contamination may impact the sanitary condition of shellfish in the area. Because fecal coliform bacteria are not always good indicators of the presence of disease-causing viruses and other pathogens, DOH depends on thorough evaluations of pollution sources. DOH temporarily closes Approved shellfish growing areas when events such as floods or biotoxin blooms occur.

#### CONDITIONALLY APPROVED

A growing area that meets Approved criteria only during predictable periods may be classified as Conditionally Approved. For example, in some growing areas DOH has been able to show that Approved criteria are met except for several days following a particular amount of rainfall. DOH manages the area by closing it for a specified time period following that quantity of rainfall.

#### RESTRICTED

If the bacteriological water quality of a commercial growing area does not meet the

standard for an Approved classification, but the sanitary survey indicates only a limited degree of pollution, the area may be classified as Restricted. Shellfish harvested from Restricted growing areas cannot be marketed directly, but must be “relayed” to an Approved growing area where they will naturally purge themselves of contaminants. The cleansing period required is generally a few weeks to several months. Restricted classifications are only considered where levels of pollution are low and relay times are shown to purify the shellfish prior to marketing.

### **PROHIBITED**

A growing area must be classified as Prohibited when information indicates that fecal material, pathogenic microorganisms, or poisonous or deleterious substances may be present in dangerous concentrations. Marine waters adjacent to sewage treatment plant outfalls, marinas, and other persistent or unpredictable pollution sources must be classified as Prohibited. *Commercial harvests of shellfish are not allowed from Prohibited areas.*

Under the National Shellfish Sanitation Program, if DOH has not conducted a sanitary survey, it must classify the growing areas as Prohibited.

### **Process**

The commercial growing area classification process is called a “sanitary survey” and consists of three parts. These are:

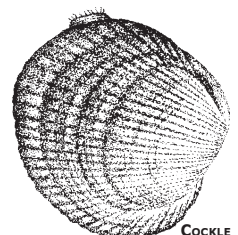
- 1) The “shoreline survey,” an investigation of point and nonpoint pollution sources that may impact shellfish sanitation;
- 2) The “marine water quality evaluation,” an analysis of the bacterial water quality in the marine water; and
- 3) The “meteorological and hydrographic evaluation,” an analysis of meteorological and hydrographic factors that may affect the distribution of pollutants in the area.

The purpose of the pollution source surveys and water quality studies are to ensure that the area complies with the standards associated with its classification, to modify the classification when needed, and to notify the responsible agencies about identified contamination sources. Monitoring data and reports resulting from these studies are transmitted to local governments and the Department of Ecology. These reports are available to interested parties upon request. For more information on the classification process, contact Bob Woolrich at (360) 236-3329.

In addition to water quality monitoring and shoreline surveys, paralytic shellfish poisoning and domoic acid samples are collected in classified areas on a routine basis. (Refer to section on Marine Biotoxins).

### **Shoreline Survey**

The shoreline survey component of the sanitary survey consists of the periodic evaluation of all point and nonpoint



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contamination sources located where they have the potential to impact the growing area. Sources are identified and evaluated through field surveys conducted by DOH in cooperation with local health departments, Tribes, and the Department of Ecology. Emphasis is placed on general shoreline activity, on-site sewage systems, animal farms, drainage ways, and wildlife activity. Pollution sources needing correction are referred to the appropriate pollution control agencies for action. DOH also evaluates the actual and potential impacts of point sources, and establishes closure zones around wastewater treatment plants and marinas.

During 2001, DOH completed shoreline surveys within 10 classified commercial growing areas and 8 proposed growing areas. Three shoreline surveys were completed that expanded the Approved portion of previously classified areas. The completed shoreline surveys encompassed 144 marine shoreline miles, 3,051 shoreline and upland parcels, and 446 drainage/discharge points. For more information regarding shoreline surveys contact Scott Berbells at (360) 236-3324.

#### **MARINE WATER QUALITY**

Marine water samples are collected to measure the concentration of fecal coliform bacteria in the growing waters. The concentration of fecal coliform bacteria can indicate the presence of pathogens that transmit hepatitis, salmonella, and other diseases to humans. DOH conducts water quality sampling throughout the



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year in all active commercial shellfish growing areas.

In 2001, DOH collected over 10,000 marine water quality samples from 1,405 sampling stations. For more information regarding marine water quality sampling and station locations contact Jerry Lukes at (360) 236-3319.

#### **METEOROLOGICAL AND HYDROGRAPHIC FACTORS**

Meteorological and hydrographic information is used by DOH to determine the extent and impact from a known pollution source on a shellfish growing area. This information is obtained from other agencies as well as from studies done by DOH and is described in more detail in the Closure Zone Determination section of this report. For more information regarding meteorological and hydrographic factors contact Frank Meriwether at (360) 236-3321.

### **STATUS OF COMMERCIAL SHELLFISH GROWING AREAS**

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In 2001, DOH classified 84 commercial growing areas in the state, covering over 200,000 acres. Many of the classified harvest areas had multiple classifications. For example, in the area called Nisqually Reach, DOH classified portions as Approved, Conditionally Approved, Restricted, and Prohibited.

In 2001, we had 78 growing areas with Approved classifications, 15 with Conditionally Approved classifications, and 6 with Restricted classifications.



DOH closed the 15 Conditionally Approved areas under the following types of predictable pollution circumstances:

- ♦ Rainfall closures;
- ♦ Sewage treatment plant upsets;
- ♦ Seasonal closures due to marinas; and
- ♦ Seasonal closure due to water quality degradation.

Figure 1 lists the Conditionally Approved areas managed by rainfall.

Since 1981, the department has downgraded the classification of about 47,000 acres as the result of declines in sanitary conditions, but has upgraded only about 13,000 acres. In the 1980s, the department downgraded the classification of almost 33,000 acres, but upgraded only about 1,000 acres. However, in the 1990s, the total acres upgraded and downgraded were nearly equal. These classification changes are shown in Figure 2.

In 2001, the department reclassified five growing areas. Parts of Filucy Bay,

Dungeness Bay, and Henderson Inlet were downgraded. Parts of Burley Lagoon and Rocky Bay were upgraded. Figure 3 shows the reclassifications of intertidal shellfish growing areas done in 2001.

## Threatened Shellfish Growing Areas

At the beginning of each calendar year the department reviews the classification and develops an annual report for each of our shellfish growing areas. During this process, we identify those shellfish growing areas that marginally meet their classification. We consider these areas to be "threatened with downgrades" and we put them on an "early warning list." We then notify stakeholders and issue a press release about the threatened areas.

The list and the reports are sent to the Pacific Coast Shellfish Growers Association, the Northwest Indian Fisheries Commission, the Puget Sound Action Team, and the

*Continued on page 10*

*Figure 1. 2001 Conditionally Approved Areas Managed by Rainfall*

Area	Closure Criteria	Closure Length	No. of Closures	Days Closed
Filucy Bay	≥0.5" rainfall / 24 hr.	5 days	28	107
Grays Harbor	≥1.0" rainfall / 24 hr. or STP upset	7 days	16	86
Henderson Inlet	≥0.5" rainfall / 24 hr.	5 days	26	103
Nisqually Reach	≥1.0" rainfall / 24 hr.	5 days	9	33
North Bay	≥0.5" rainfall / 24 hr.	5 days	32	123
Oakland Bay	≥1.0" rainfall / 24 hr.	5 days	12	49
South Skagit Bay	≥0.5" rainfall / 24 hr.	5 days	15	64



Figure 2. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Bay Center (Pacific Co.)	11/89	Approved to Prohibited	1,590	Rural nonpoint	9/92	Prohibited to Conditionally Approved	1,030	Improvement in shoreline conditions
					10/99	Conditionally Approved to Approved	340	Improved water quality results
					6/00	Conditionally Approved to Approved	690	Improved water quality results
Burley Lagoon (Pierce Co.)	1981	Approved to Restricted	210	Rural nonpoint	10/93	Restricted to Conditionally Approved	210	Correction of sewage system failures and agricultural waste problems
	1/99	Conditionally Approved to Restricted	210	Rural nonpoint	1/99	Prohibited to Restricted	20	Administrative change only
					5/01	Restricted to Approved	110	Correction of sewage system failures and agricultural waste problems
Chico Bay / Dyes Inlet (Kitsap Co.)					12/93	Prohibited to Restricted	150	Reevaluation of point sources
Dosewallips (Jeff. Co.)	9/87	Approved to Restricted	180	Marine mammals (seals)	4/94	Restricted to Approved	30	Seals access to shoreline area was restricted
Drayton Harbor (What. Co.)	1988	Approved to Prohibited	620	Rural nonpoint				
	1/95	Approved to Restricted	30	Point source and rural nonpoint				
	1/95	Approved to Prohibited	1,010	Point source and rural nonpoint				
	9/99	Approved to Prohibited	920	Various point and nonpoint pollution sources				
Duckabush (Jeff. Co.)	7/88	Approved to Restricted	630	Rural nonpoint	3/01	Restricted to Approved	630	Improved water quality

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Dungeness Bay (Clallam County)	1/00	Approved to Prohibited	300	Area near mouth of river closed due to rural nonpoint pollution				
	4/01	Approved to Prohibited	100	Rural nonpoint pollution				
Eld Inlet (Thurs. Co.)	2/83	Approved to Conditionally Approved	690	Rural nonpoint	2/98	Conditionally Approved to Approved	450	Repair of on-site sewage systems and improved farm practices
Filucy Bay (Pierce Co.)	8/01	Conditionally Approved to Prohibited	7	Rural nonpoint pollution				
Grays Harbor (Grays Harbor Co.)					11/94	Conditionally Approved to Approved	17,370	Not the result of changes in sanitary conditions, but rather a reevaluation of hydrography
Hammersley Inlet (Mason Co.)					6/92	Prohibited to Approved	200	Not the result of changes in sanitary conditions, but rather a reevaluation of sewage treatment plant discharge and water quality
Henderson Inlet (Thurs. Co.)	1984	Approved to Conditionally Approved	180	Nonpoint				
	1985	Conditionally Approved to Prohibited	120	Nonpoint				
	9/00	Conditionally Approved to Prohibited	8	Nonpoint				
	6/01	Approved to Conditionally Approved	300	Nonpoint				

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Liberty Bay (Kitsap Co.)	5/91	Conditionally Approved to Restricted	260	Rural and urban nonpoint	4/94	Restricted to Approved	70 (Lemolo Area)	Correction of on-site sewage system failures and re-evaluation of hydrographics
Lilliwaup Bay (Mason Co.)	7/98	Approved to Prohibited	22	Area failed fecal coliform standard; wildlife most likely cause				
Lower Hood Canal (#9) (Mason Co.)	1987	Approved to Prohibited	630	Rural nonpoint	10/96	Restricted to Approved	530	Correction of on-site sewage system failures
	2/93	Approved to Prohibited	960	Rural nonpoint including on-site sewage system failures	5/98	Prohibited to Approved	400	Repairs of on-site sewage systems
Minter Bay (Pierce Co.)	1982	Approved to Prohibited	60	Rural nonpoint				
Nisqually Reach (Thurs. Co.)	6/92	Approved to Conditionally Approved	2,130	Rural nonpoint				
	9/00	Conditionally Approved to Restricted	74	Rural nonpoint	9/00	Conditionally Approved to Approved	20	Improved water quality results
North Bay (Mason County)	5/91	Approved to Prohibited	1,260	On-site sewage system failures	10/91	Prohibited to Conditionally Approved	450	Correction of on-site sewage system failures
					6/92	Prohibited to Conditionally Approved	710	Correction of on-site sewage system failures
					10/92	Prohibited to Restricted	100	Correction of on-site sewage system failures
North River (Pacific County)					7/98	Prohibited to Approved	900	On-site systems discharging to Willapa River connected to sewer
Oakland Bay (Mason Co.)	2/87	Conditionally Approved to Restricted	1,380	Urban point and nonpoint	4/89	Restricted to Conditionally Approved	1,380	Improvement in water quality

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Penn Cove (Island Co.)	1983	Conditionally Approved to Prohibited	500	Sewage treatment plant	1/95	Prohibited to Conditionally Approved	450	Sewage treatment plant and nonpoint source improvements
Port Gamble Bay (Kitsap Co.)	7/96	Approved to Prohibited	20	Rural nonpoint	3/99	Prohibited to Approved	20	Rural nonpoint sources corrected
Port Susan (Snoh. & Island Co.)	5/87	Approved to Restricted	11,900	Agricultural nonpoint/ sewage treatment plant				
Portage Bay (What. Co.)	8/97	Approved to Restricted	60	Rural nonpoint				
	9/99	Approved to Restricted	90	Rural nonpoint				
Quilcene Bay (Jeff. Co.)	1984	Approved to Prohibited	200	Rural nonpoint				
Rocky Bay (Mason Co.)	8/95	Approved to Prohibited	30	Rural nonpoint	12/01	Prohibited to Approved	15	Rural nonpoint pollution corrected
Samish Bay (Skagit Co.)	8/94	Approved to Restricted	490	Agricultural, rural nonpoint including on-site sewage system failures				
	8/94	Approved to Prohibited	2,200	Agricultural, rural nonpoint including on-site sewage system failures	5/98	Restricted to Approved and Prohibited to Conditionally Approved	835	Repair of sewage problems in near shore communities
Sequim Bay (Clallam Co.)	2/92	Approved to Prohibited	200	Sewage treatment plant				
	2/92	Approved to Conditionally Approved	2,830	Sewage treatment plant	6/98	Conditionally Approved to Approved	2800	Sewage treatment plant upgrade and relocation of outfall
					1/00	Prohibited to Approved	750	Sewage treatment plant upgrade and relocation of outfall

Figure 2 Continued. Commercial Shellfish Growing Area Reclassifications Since 1981

Growing Area	Classification Downgrades				Classification Upgrades			
	Year	Change	Acres	Reason	Year	Change	Acres	Reason
Similk Bay (Skagit Co.)	7/00	Approved to Prohibited	60	Failing on-site sewage systems				
South Skagit Bay (Skagit Co.)	3/87	Approved to Restricted	6,140	Rural, agricultural nonpoint	9/93	Restricted to Conditionally Approved	2,280	Sewage treatment plant performance and correction of agricultural waste problems
Squaxin Island (Mason Co.)					7/93	Prohibited & Conditionally Approved to Approved	50	Removal of boat dock and mooring buoys

Figure 3. 2001 Reclassifications of Intertidal Shellfish Growing Areas

Growing Area	County	Classification	Acres
Burley Lagoon	Pierce	Restricted to Approved	110
Dungeness Bay	Clallam	Approved to Prohibited	100
Henderson Inlet	Thurston	Approved to Cond. Approved	300
Filucy Bay	Pierce	Cond. Approved to Prohibited	7
Rocky Bay	Pierce	Prohibited to Approved	15

Department of Ecology. In addition, we send reports to the local health departments and send individual growing area reports to shellfish growers who harvest in threatened areas. The objective is to correct pollution problems before we have to close an area or downgrade its classification.

Downgrades in classification are bad news. They restrict or eliminate commercial harvesting of shellfish; they close public shellfish beaches to recreational shellfish

harvesters; and they indicate that pollution is getting worse. Downgrades also require a reaction. When an area is downgraded due to nonpoint pollution, state law requires local governments to form shellfish protection districts to address the problem.

According to our analysis in March of 2002, all commercial shellfish growing areas met their current classifications. However, 16 areas were identified as "threatened" (see Figure 4). They include:

- ♦ Dungeness Bay (Clallam County)
- ♦ Pysht (Clallam County)
- ♦ Grays Harbor (Grays Harbor County)
- ♦ Port Gamble / Cedar Cove (Kitsap County)
- ♦ Annas Bay (Mason County)
- ♦ Hood Canal near Forest Beach (Mason County)
- ♦ Lynch Cove (Mason County)
- ♦ Oakland Bay (Mason County)
- ♦ North Bay (Mason County)
- ♦ Naselle River (Pacific County)
- ♦ Drayton Passage (Pierce County)
- ♦ Oro Bay (Pierce County)
- ♦ Rocky Bay (Pierce County)
- ♦ Henderson Inlet (Thurston County)
- ♦ Nisqually Reach (Thurston County)
- ♦ Portage Bay (Whatcom County)

For more information on threatened shellfish growing areas, contact Bob Woolrich at (360) 236-3329.

## **Fecal Coliform Status and Trends in Commercial Shellfish Beds**

DOH participates with other agencies in the Puget Sound Ambient Monitoring Program (PSAMP) to assess the health of Puget Sound. DOH has recently determined fecal coliform pollution status and trends for 89 shellfish areas\* in Puget Sound for the year ending in March 2001.

DOH addresses two questions for PSAMP (see Puget Sound Ambient Monitoring Program section for more information on PSAMP):

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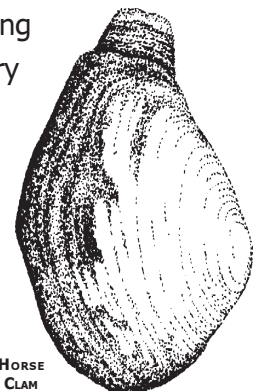
*\* incorporates unclassified areas not included in Growing Area status on page 4*

- ♦ What is the status of fecal pollution in shellfish beds?
- ♦ Has fecal pollution changed over time?

To answer these questions, fecal coliform statistics used by DOH to classify growing areas (geometric means and ninetieth percentiles) were adapted to meet PSAMP objectives. The PSAMP procedure is nearly identical to that used for classifying growing areas. However, classification requires additional data and calculations beyond the scope of PSAMP. For PSAMP, statistics were calculated for each sampling date starting from the earliest date having the minimum required number of prior results (30) forward to the most recent date (late March 2001).

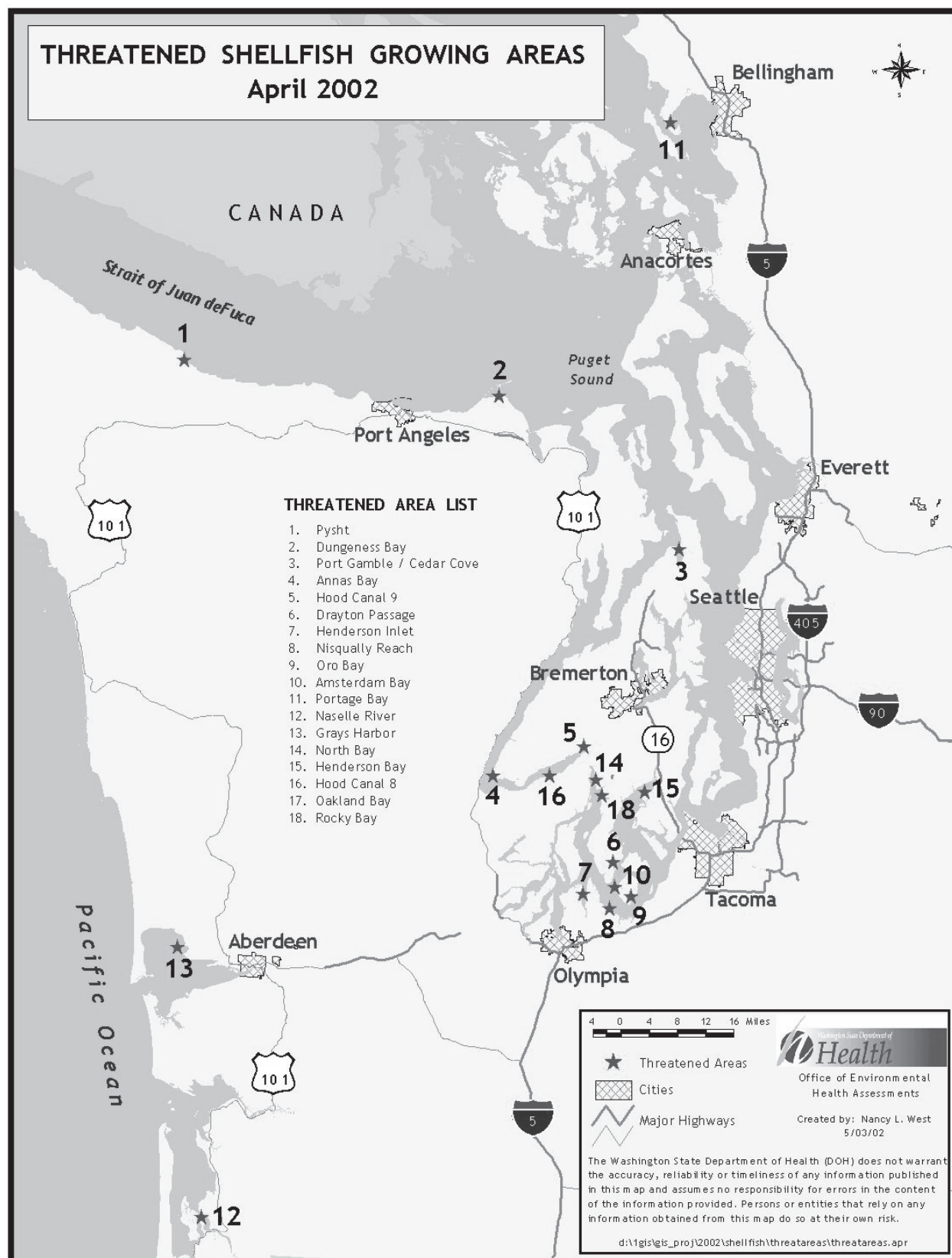
### ***Status of fecal coliform pollution in shellfish growing areas***

Over 1100 stations in 89 growing areas in Puget Sound were assessed for PSAMP. The status of each growing area was determined for the period from January 2000 through March 2001. Each station within a growing area was categorized according to the highest ninetieth percentile occurring at the sampling station during the period: **GOOD** (0-30 MPN per 100 ml), **FAIR** (31-43 MPN per 100 ml) or **BAD** (above 43 MPN per 100 ml). The fraction of sampling stations within each category was used to produce a pie chart. Pie charts for each growing area provide a means to visually compare 89 growing areas in Puget



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Figure 4. Threatened Shellfish Growing Areas





Sound and the straits of Georgia and Juan de Fuca (Figure 5). South Skagit Bay, Drayton Harbor, and Chico Bay (Dyes Inlet) appear to be the most affected by fecal pollution. (Note: Figure 5 sorts the 89 growing areas into six regions: (1) North Puget Sound and Georgia Strait, (2) Admiralty Inlet and the Puget Sound Main Basin, (3) South Puget Sound, (4) San Juan Islands, (5). the Strait of Juan de Fuca, and (6) Hood Canal.)

### ***Ranking of fecal impact in growing areas and regions.***

Each growing area was ranked according to fecal pollution impact by calculating a "Fecal Pollution Index" or FPI. First, the fraction of stations within each category was multiplied by a corresponding weighting factor (GOOD: 1.0; FAIR: 2.0; or BAD: 3.0). Next, the resulting weighted fractional values are added to produce the FPI. If all stations in the growing area are GOOD, the index is 1.0 (1.00 x 1.0). On the other hand an index of 3.0 means all stations are BAD (1.00 x 3.0). A growing area with a mixture of categories would fall between the extremes. Figure 6 arrays the indices of 30 growing areas (a third of the total) with indices greater than 1.0. The bar graphs in Figure 6 agree with our visual impressions from Figure 5. South Skagit Bay has been affected the most (FPI = 2.8), followed by Drayton Harbor (FPI = 2.6) and Chico Bay (FPI = 2.3).

The concept of calculating FPI was extended to the level of the region. For each region the total of stations within each category (GOOD, FAIR, BAD) was calculated. Next the

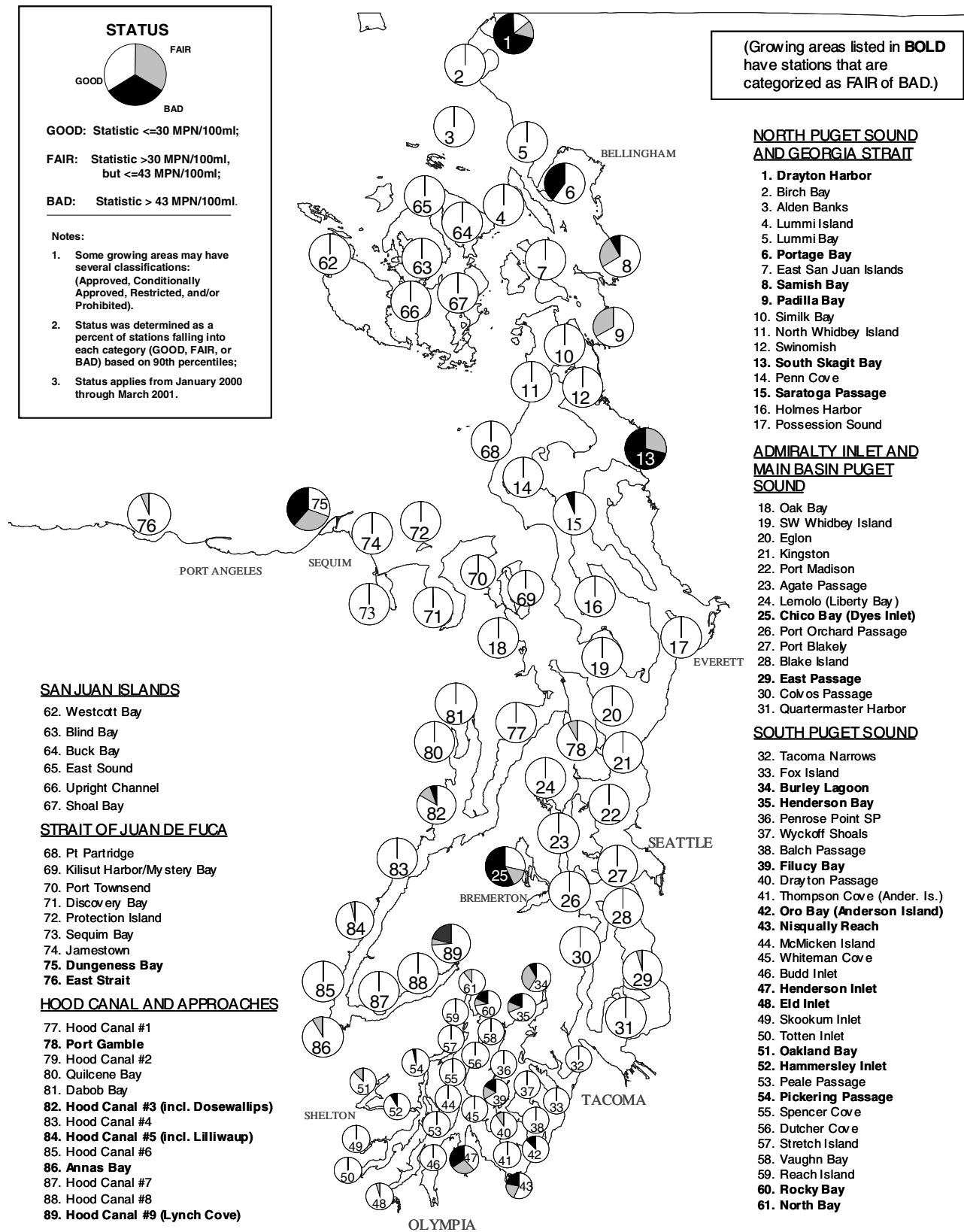
weighted proportion of stations in each category was determined as described above. The weighted proportions were summed to produce an FPI for each of the regions: The FPI for North Puget Sound/Georgia Strait was nearly identical to that of South Puget Sound (FPI = 1.28 and 1.25, respectively). Next in order came the Strait of Juan de Fuca (FPI = 1.12), Admiralty Inlet and the Main Basin (FPI = 1.08), Hood Canal (FPI = 1.06), and the San Juan Islands (FPI = 1.0).

### ***Trends in fecal coliform contamination***

The period of record for many growing areas extends back for over a decade. However, the time period for this year's PSAMP trends analysis was limited to five years prior to March 2001 to detect recent changes. Trends in 90<sup>th</sup> percentiles were analyzed for stations that had: 1) 90<sup>th</sup> percentiles greater than 10 MPN per 100 ml, or 2) a length of record longer than three years or both. There were 302 "trends" stations (27% of total stations) located in nearly half of the 89 growing areas analyzed for PSAMP. About 40% of the "trend" stations showed significant upward trend (i.e., getting worse). A third improved and the remaining 27% had not changed significantly.

Of the impacted growing areas (an FPI of >1.0), Henderson Inlet had the greatest percentage of worsening stations in Puget Sound (15 of 26 stations). Other impacted areas with noteworthy upward trends were South Skagit Bay in North Puget Sound (9 of 14 stations are getting worse) and Dungeness

Figure 5. Fecal Coliform Pollution in Shellfish Growing Areas



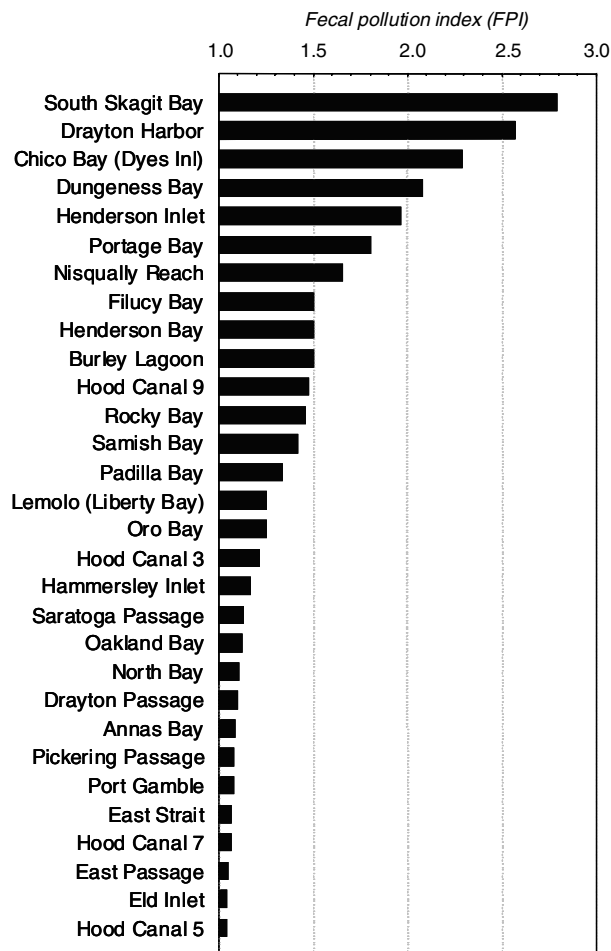
Bay on the Strait of Juan de Fuca (11 of 13 stations are getting worse). Worsening trends were generally associated with poor status in most cases (i.e., Henderson Inlet, Skagit and Dungeness bays). However, this was not always the case. Buck Bay (San Juan Islands) had 4 of 5 stations worsen, and in Port Blakely (Bainbridge Island) 6 of 8 stations worsened. The current status of both Buck Bay and Port Blakely are GOOD (i.e., Approved for harvest), although their worsening trends suggest vigilance is in order.

## Closure Zone Determinations

Shellfish are filter feeders, and they can accumulate and concentrate nearby disease-causing organisms. Therefore it is important that the public be protected from consuming shellfish located near actual and potential sources of pollution. Closure zones are established by DOH around sources of pollution to prevent harvest and consumption of contaminated shellfish. Typical sources are sewage treatment plants, marinas, and nonpoint sources such as river discharges or runoff from watersheds following heavy rainfall. For example, there are more than 60 sewage treatment plant outfalls discharging to the marine waters of the state, some near shellfish growing areas. The daily discharge from these treatment plants varies greatly, from tens of thousands of gallons at small plants to over one hundred million gallons at the largest facilities.

DOH conducts a technical evaluation for each sewage treatment plant and marina located near an area of commercial or public recreational shellfish harvest. Evaluations for each potential pollution source include inspecting the facility by the DOH engineer, gathering information on water currents and characteristics near the site, and evaluating the dilution and dispersion of any wastewater discharged from the facilities. Frequently DOH conducts its own studies to better understand the movements of marine waters in the area if such information is not available, or works with the consultants of these facilities to generate the information. DOH studies can include the measurement of dye injected into

Figure 6. Shellfish Growing Areas Ranked by Fecal Pollution Index



a treatment plant's discharge by boat-mounted equipment, and the use of fix-depth floats to study the dilution, current speed and direction in the nearby marine waters. DOH uses this information collected at marinas and sewage treatment plants in computer models to calculate the size of closure zone for each facility, using the protective assumption that an unplanned upset event or waste discharge has occurred. In addition, each sewage treatment plant is required to call DOH immediately if a bypass occurs, or if a problem occurs with the disinfection system. In turn, DOH may close the designated area near a pollution discharge event to commercial and public recreational shellfish harvesting, and contacts stakeholders such as county health departments, tribal and non-tribal shellfish harvesters, and the Washington State Department of Fish and Wildlife. Using this approach, the public is protected from consuming contaminated shellfish near potential pollution sources, even during unusual conditions. For more information contact Frank Meriwether at (360) 236-3321.

## **SHELLFISH GROWING AREA RESTORATION PROGRAM**

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The goal of the DOH Shellfish Office Restoration Program is to reopen commercial and recreational shellfish beds that have been closed or had restrictions placed on harvest and to prevent the closure of shellfish areas that are still open but threatened. The

Restoration Program works cooperatively with entities such as local governments, the Puget Sound Water Quality Action Team, Tribes, and the Department of Ecology. Program activities include notifying affected parties about classifications that are threatened, water quality testing, participating in surveys to identify pollution sources, serving as a member or advisor on watershed committees, and assisting in the development of watershed management plans and closure response plans.

## **Restoration Projects**

DOH Restoration Program projects in 2001 included:

Dungeness Bay (Clallam County) One hundred acres in Dungeness Bay were downgraded from Approved to Prohibited in 2001. Restoration Program personnel are working with county, state, tribal and federal agencies to identify and correct the pollution sources responsible for the downgrade. The Department of Ecology is conducting a fecal coliform loading study of the watershed.

Henderson Inlet (Thurston County) Three hundred acres were downgraded from Approved to Conditionally Approved in 2001. A shellfish protection district was formed by Thurston County. Restoration Program personnel are continuing to work with county and state agencies to identify and correct the pollution sources responsible for the downgrade.

Nisqually Reach (Thurston County) Thurston County formed a shellfish protection district in response to a downgrade in classification near the mouth of McAllister Creek in 2000.

Restoration Program personnel are continuing to work with county and state agencies to identify and correct the pollution sources.

Lower Hood Canal (Mason County) DOH and Mason County are continuing efforts in the Prohibited portion of Lower Hood Canal to identify the pollution sources responsible for the elevated levels of fecal coliform bacteria. Two large onsite sewage systems impacting Belfair State Park tidelands were found to be failing on the north shore. Corrections are underway.

Burley Lagoon (Pierce and Kitsap Counties) One hundred ten acres were upgraded from Restricted to Approved in 2001. Pierce and Kitsap Counties have been conducting door-to-door pollution source surveys and continue to find and correct problems.

Rocky Bay (Pierce County) DOH upgraded thirty acres from Prohibited to Approved. The Tacoma-Pierce County Health Department found and corrected failing onsite septic systems, and the Pierce County Public Works Department remedied storm water problems.

Filucy Bay (Pierce County) DOH downgraded seven acres from Conditionally Approved to Restricted. A closure response strategy has been developed and restoration work has begun. The problems are related to animal keeping practices in the watershed.

Hood Canal #3 (Jefferson County) Six hundred thirty acres of the Duckabush River delta were upgraded from Restricted to Approved.

North Bay (Mason County) Work was completed on a community sewer system for the communities surrounding North Bay. The area is being evaluated for a possible upgrade in classification.

Drayton Harbor (Whatcom County) The entire embayment of Drayton Harbor was downgraded to Prohibited in 2000 due to poor water quality. Restoration Program personnel continue to work with the Citizens Watershed Committee, the City of Blaine Public Works Department, various Whatcom County agencies, and the Northwest Indian College to solve a complex of pollution problems.

Portage Bay (Whatcom County) Water quality continues to improve in the Nooksack River watershed and in the shellfish growing area in Portage Bay due to extensive work by Lummi Natural Resources, Northwest Indian College, Department of Ecology, and Whatcom County Water Resources.

Samish Bay (Skagit County) Ongoing work by the Skagit County Health and Public Works Departments has resulted in improved water quality, particularly in the conditionally approved portion, where an upgrade to Approved is being evaluated.

Similk Bay (Skagit County) Following the downgrade of the northwest portion of Similk Bay in 2000, the Skagit County Health

Department dye-tested the onsite septic systems of the Similk Beach community and found a high percentage of failures. A community sewage system is being considered.

Oro Bay (Pierce County) The Tacoma-Pierce County Health Department and DOH have conducted investigative sampling to further identify fecal coliform sources impacting the bay. The county is currently seeking a grant to conduct a wide area survey of onsite sewage systems around Oro Bay.

For further information on the Restoration Program, contact Don Melvin at (360) 236-3320.

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## **PUGET SOUND AMBIENT MONITORING PROGRAM**

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The Department of Health Office of Food Safety and Shellfish Programs participates in the Puget Sound Ambient Monitoring Program (PSAMP). The goals of PSAMP are to:

- ♦ Assess the health of Puget Sound and its resources;
- ♦ Identify existing environmental problems;
- ♦ Provide data to help the Puget Sound Water Quality Action Team and others measure the success of environmental programs;
- ♦ Provide a permanent temporal record of significant natural and human-caused changes in key environmental indicators in Puget Sound; and
- ♦ Support research activities by making available scientifically valid data.

The primary goal of DOH is to assure the health and safety of shellfish consumers. Information gathered by DOH programs can also be used to meet the broader goals of PSAMP.

Data are drawn from two office programs: the Biotoxin Monitoring Program and the Commercial Areas Water Quality Monitoring Program. In recent years these data have been analyzed for PSAMP and publicly presented through several channels, including DOH technical reports, publications of the Puget Sound Water Quality Action Team (Puget Sound Update, Soundwaves), posters and demonstrations at regional fairs, and presentations at scientific meetings (Puget Sound Research Conference, Pacific Rim Shellfish Sanitation Conference, and the Pacific Coast Oyster Growers Association meeting).

Summaries of the 2001 PSAMP analyses are contained in this report as parts of Fecal Coliform Status and Trends in Commercial Shellfish Beds (page 11) and Marine Biotoxin Monitoring Program (page 29).

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## **LICENSING AND CERTIFICATION PROGRAM**

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DOH's Shellfish Licensing and Certification Program is a statewide program designed to protect the public health by licensing and certifying all commercial bivalve molluscan shellfish companies in Washington State. This program ensures that standards are met in the handling, processing, packaging, buying, storage and distribution of shellfish. Through



formal agreement with the Department of Fish and Wildlife, shellfish growing areas are patrolled to prevent the illegal harvest of shellfish from unsafe, polluted waters.

## **Washington State Shellfish Industry**

Washington State is among the top shellfish producing states in the nation, and is recognized as having one of the nation's safest supplies of shellfish. The success in assuring that Washington shellfish are among the safest in the nation is due to the cooperative efforts of DOH, the Washington Tribes and the shellfish industry.

The commercial shellfish licensing year runs from October 1 through September 30 each year for Shellstock Shippers and Shucker Packers licenses, and from April 1 through March 30 for Harvester licenses. In 2001, the Washington state shellfish industry consisted of approximately 320 licensed, certified shellfish operations. Approximately 26 firms were licensed as *shucker-packers* (shellfish processing firms), 193 as shellstock shippers, and 101 as *harvesters*. DOH performed 609 routine inspections of licensed shellfish operations during the 2000-2001 license year.

### ***Shucker-Packers***

Shucker-packer firms either harvest or purchase shellstock, then process it in their plants by shucking, washing, and packing the meats for sale to retail markets. These processing plants are inspected for shellfish

sanitation compliance a minimum of four times a year. DOH performed 106 inspections on shucker-packer firms during the October 2000-September 2001 license year.

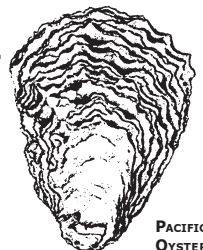
### ***Shellstock-Shippers***

Shellstock-shipper firms either harvest, purchase or reship shellstock for sale to retail markets or to other shellfish dealers. Their licenses are limited to the sale of shellstock or shucked shellfish from other license holders only; these firms are not permitted to shuck shellfish. Shellstock-shippers firms are inspected an average of two times per year. DOH performed 379 inspections on shellstock-shipper firms during the 2000-2001 license year.

### ***Harvesters***

Harvester firms are limited to harvesting shellstock and selling it intrastate (only within the state of Washington) to licensed shucker-packer firms or shellstock-shipper firms. They are not permitted to purchase shellstock, nor sell it to retail. Harvesters are not permitted to shuck shellstock, or store shellstock. Harvester operations are inspected once per license year. DOH performed 124 inspections of harvester firms during the 2000-2001 license year.

For further information contact  
Judy Dowell at (360) 236-3313.



PACIFIC  
OYSTER



## **TRIBAL SHELLFISH SANITATION PROGRAM**

2001 began the eighth year of the Tribal Shellfish Sanitation Program when the *U.S. v. Washington* shellfish subproceeding commenced in the United States District Court of Western Washington. Progress has been made in establishing and maintaining a cooperative program with the tribes and the Department of Health (DOH). Currently, fourteen treaty tribes are certified and licensed by the Department. Those licensed as harvesters are the Makah Tribe, the Nisqually Tribe, the Port Gamble S'Klallam Tribe, the Puyallup Tribe, and the Squaxin Island Tribe. Those licensed as interstate shellstock shippers are the Jamestown S'Klallam Tribe, the Lower Elwha Klallam Tribe, the Lummi Indian Nation, the Muckleshoot Tribe, the Skokomish Tribe, the Suquamish Tribe, the Tulalip Tribes, and the Skagit System Cooperative. Three tribes - the Upper Skagit Tribe, Sauk-Suiattle Tribe, and Swinomish Tribe - make up the Skagit System Cooperative. The Quinault Indian Nation and the Squaxin Island Tribe have licensed shucker packer operations. Forty-two individual tribal members have voluntarily requested to have their harvesting operations inspected, even though they are not required to under the Consent Decree, as they harvest under the Tribe's certification as members of a tribe. Thirty-two individual tribal operations, owned and operated by tribal members, have applied for and received shellfish operation licenses. All of the certified Tribal shellstock shipper and shucker-packer

operations have developed Hazard Analysis Critical Control Point (HACCP) Plans.

Ongoing DOH/Tribal technical meetings have enhanced the joint cooperation in protecting public health. These meetings have produced protocols, which include the harvest of wild seed, the harvest of molluscan bivalve shellfish for bait, and the protection of public health from the harvest and sales of non-molluscan shellfish species. Other technical issues have arisen such as biotoxin testing for crab and in the visceral ball of the geoduck clam. Through the cooperative efforts of this office and the Tribes, the need for annual lists of tribal growing area classification requests, which includes growing areas where tribes desire to harvest shellfish, have been discontinued. As a Tribe establishes an interest in a growing area, the Tribe notifies this office in writing, requesting the area be classified, if not already classified. Before any harvest, each beach or geoduck tract classification request is reviewed under the requirements of the National Shellfish Sanitation Program (NSSP). Tribal personnel continue to assist with water quality monitoring for this task. Continued development of joint protocols and training, as needed, are priorities for this program. Through joint efforts by this Program, a process for Harvest Site Application and Certification of Private Owned Tidelands was developed and adopted.

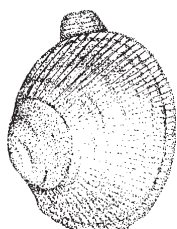


GEODUCK  
CLAM

Tribal geoduck harvesting operations exist in the Strait of Juan de Fuca, Hood Canal, and the central and south Puget Sound. Geoduck boats, vehicles, and facilities are inspected for sanitation and proper handling of commercial product. Tribal monitors and patrol officers are working with DOH to ensure a safe product by enforcing rules for harvesting in approved and open areas only. The tribes also supply geoduck for biotoxin sampling, and tribal and non-tribal harvesters share the results of analyses.

Continued cooperation between local health jurisdictions and tribes has been enhanced with consolidated contracts managed by DOH. Clallam County Department of Health and Human Services and the Jamestown S’Klallam Tribe sample the public beach at Jamestown for biotoxins and are working together to look for potential pollution sources in the Dungeness River watershed. The Lummi Indian Nation and Whatcom County Health and Human Services Department are jointly monitoring the Nooksack River for potential pollution sources. Continued cooperation between local health jurisdictions and the tribes is ensuring shellfish growing areas remain open and approved.

In addition to establishing programs specific to commercial endeavors, cooperative efforts also benefit subsistence and recreational



shellfish harvesters. The Quileute Tribe continue to conduct a coastal biotoxin monitoring program funded by the federal

government. The tribes contract with DOH’s biotoxin laboratory to test for paralytic shellfish poison (PSP) and domoic acid in shellfish collected on several north Pacific coast beaches. The results are shared with all coastal shellfish harvesters. Tribal sampling helped identify that domoic acid levels in razor clams were rising to record levels in 1998.

Overall, tribal involvement continues to result in increased public health protection and awareness of Washington shellfish sanitation issues. For more information, please contact Jessie DeLoach at (360) 236-3302.

## ***VIBRIO PARAHAEMOLYTICUS*** **IN WASHINGTON STATE**

DOH implements the 1999 ISSC Conference Interim *Vibrio parahaemolyticus* Plan.

Routine shellfish testing is part of the control plan. Figure 7 shows the results of routine sampling of oysters from 4 representative commercial growing areas in Washington with

Figure 7. 2001 *Vibrio Parahaemolyticus* levels

Area V.p. > 100	Level	Date
Eld Inlet	4,620	7/24/01
Hood Canal N. (Quilcene)	240	7/16/01
Hood Canal N. (Quilcene)	149	8/13/01
Hood Canal S. (Annas Bay)	240	7/9/01
Hood Canal S. (Annas Bay)	149	7/16/01
Totten Inlet	240	8/14/01

significant levels of *Vibrio parahaemolyticus* (V.p) during the summer of 2001.

## Vibrio Illnesses

There were a total of 5 confirmed cases of vibriosis linked to Washington molluscan shellfish during 2001. Of these:

- ♦ Four cases were traced to oysters commercially harvested in Washington.
- ♦ One case was traced to oysters recreationally harvested in Washington and consumed raw.

There were no vibriosis cases from multi-source locations that included Washington product, nor were there any cases from out-of-state product.

There was one confirmed case of vibriosis from unknown sources. The oysters in this case were consumed raw.

Figure 8 provides a breakout of the pertinent illness information relating to each category for 2001.

For more information contact Jessie DeLoach at (360) 236-3302.

Figure 8. 2001 *Vibrio Parahaemolyticus* illnesses

	Commercial WA Product	Recreational WA Product	Unknown Source or Product
Number of Confirmed Cases	4	1	1
Number ill & Harvest Sites	1 - Dabob Bay 1 - Hammersley Inlet 1 - Hammersley Inlet 1 - Hood Canal SE	1 - Harstine Island	Unknown
Harvest Dates	5/27/01 - 8/30/01	8/08/01	8/28/01 - 9/04/01
Number ill & Type of Shellfish	1 - shucked meats 1 - raw shooters 1 - raw shooters 1 - shucked meats & shellstock	1 - shucked meats	1 - shellstock
Consumed Raw	3	1	1
Consumed Cooked / Steamed/Smoked / Unknown	1 - Unknown		

## MARINE BIOTOXIN MONITORING PROGRAM

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### Paralytic Shellfish Poison

The state of Washington routinely experiences seasonal restrictions on commercial and recreational shellfish harvest due to paralytic shellfish poisoning (PSP), more commonly known as "red tide". The biotoxin that causes PSP temporarily interferes with the transmission of nerve impulses in warm-blooded animals. The primary symptoms of PSP in humans are numbness and tingling of the lips, tongue, face and extremities, difficulty talking, breathing, swallowing and muscle incoordination. Symptoms develop quickly, usually within 1-2 hours of consumption (very high levels of toxin can produce symptoms within 30 minutes), and typically disappear within 12-24 hours. There is no known antidote for the toxin. Treatment is basically supportive, i.e., artificial respiration, in life threatening cases.

PSP toxin is produced by microscopic organisms that naturally exist in marine water. The species that causes PSP in Washington marine waters is *Alexandrium catenella*. *Alexandrium* is usually present in small numbers; however, when environmental conditions are optimum, rapid reproduction occurs. Filter-feeding shellfish, which include clams, oysters, mussels and scallops, can accumulate the toxin to dangerous levels during these "blooms".



DOH monitors PSP toxin levels in shellfish from areas throughout the state. Commercial operations submit PSP samples as a condition for commercial certification. Recreational beaches are sampled as a cooperative effort between DOH, other state agencies, tribes and health departments, often utilizing citizen volunteers. Areas are closed for harvest of molluscan shellfish when PSP toxin levels equal or exceed the Food and Drug Administration standard of 80 micrograms ( $\mu\text{g}$ ) toxin/100 grams shellfish tissue. Areas are not reopened until testing has confirmed that the PSP toxin has declined to a safe level. Butter clams (*Saxidomus giganteus*) may experience extended closures because they typically retain the PSP toxin longer than other shellfish. A recreational razor clam season may be held each spring and fall depending on biotoxin levels and availability of resource.

The DOH Shellfish Program maintains a toll free 24-hour "PSP Hotline" (1-800-562-5632) identifying recreational beach closures. Local health jurisdictions also issue notices through local newspapers and radio. Beach posting is irregular depending on jurisdiction, beach ownership, susceptibility to vandalism and theft, and is not a reliable method of notification.

The Washington State Public Health Laboratory analyzed close to 3,700 PSP samples in 2001. Commercial shellfish growing areas were monitored biweekly through 2001. Selected recreational beaches were monitored biweekly from April through

October by local health jurisdictions, Adopt A Beach, Puget Sound Restoration Fund, and other volunteers. Sentinel mussel cage sites were monitored year-round.

## **2001 PSP Summary**

### ***Commercial PSP Closures***

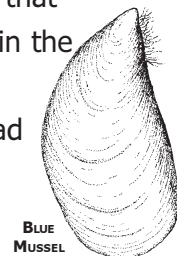
Continuing the trend of the last four years, PSP activity in 2001 in the inland waters of Puget Sound and the Strait of Juan de Fuca followed a new pattern. One aspect of the new pattern that seems to be repeating itself was the large number of commercial geoduck tract closures. There were a total of 35 geoduck tract closures in 2001. The first geoduck tract closure was in January in Carr Inlet in Pierce County. This closure may have been the result of the extremely high toxin levels that carried over from the blooms of the previous fall, compounded by sample variability, rather than representing new bloom activity. A unique aspect of 2001 was that there were no months in the year that did not have at least one geoduck tract closure. Protection Island Tract #01000 had the dubious distinction of a total of five closures in 2001. Even though the peak toxin level at Protection Island was only 375µg in September, much lower than the September 2000 peak of 2,320µg, the frequent closures significantly impacted the commercial geoduck industry. One additional distinction for 2001 was that the highest PSP toxin recorded for geoducks, 884µg, was recorded in Case Inlet at an intertidal geoduck farm. Another distinction attributed to geoducks was that intertidal geoduck PSP samples were

responsible for closing two commercial areas that had never been closed before.

The first significant PSP bloom in 2001 began in Carr Inlet at the end of May in South Puget Sound. By the end of June, most of Pierce County was closed. Grays Harbor and Willapa Bay also experienced PSP blooms in June. In July, the South Puget Sound bloom greatly expanded, closing Pickering and Peale Passages, Case, Eld and Hammersley Inlets, Filucy Bay and Burley Lagoon. This was the first commercial closure on record for Hammersley Inlet. At the same time, minor blooms continued to impact Grays Harbor and Willapa Bay, where PSP levels were high enough to activate the increased sampling contingency plans. However, commercial shellfish toxin levels did not exceed the closure level.

By August, the PSP bloom in South Puget Sound peaked and began to dissipate. Totten Inlet was closed in August for the first time ever, due to a geoduck sample from an intertidal farm. Blooms also occurred in the Olympic Peninsula area of the state, causing commercial closures in Discovery Bay and Sequim Bay and in Blakely Harbor in Central Puget Sound.

September, the month that historically produces lots of PSP blooms, only produced one new bloom in Island County that closed Penn Cove. The blooms in the rest of the state were in decline. In October, Penn Cove, which had reopened, closed and reopened and closed again. The last



BLUE  
MUSSEL

commercial area to be closed for the year, other than geoduck tracts, was Holmes Harbor in Island County in November, where the PSP toxin level exceeded 1000µg.

There were eight geoduck tract closures in the last three months of 2001.

### ***Recreational PSP Closures***

#### *First Quarter 2001*

Typically, PSP toxin levels continued a downward trend through the first quarter of 2001. This trend that began in December 2000, prompted the lifting of recreational closures in several parts of the state. The PSP levels in razor clams on the coast remained stable, between 40 and 60µg. In Puget Sound, general closures were lifted in Jefferson, King, Kitsap, Skagit and Whatcom counties.

#### *Second Quarter 2001*

The ongoing downward trend in PSP toxin continued during April and May, with many area closures being lifted or reduced from all species closures to butter clam only closures. However, this trend ended abruptly at the end of May, with the onset of a significant bloom in South Puget Sound. It began in Carr Inlet, expanding rapidly and by the end of June had closed most of Pierce County. Grays Harbor and Willapa Bay also experienced PSP blooms that occurred inside the harbors in the third week of June. By the end of the second quarter on June 30, 2001, it was quite evident that the PSP season had arrived in Washington.

#### *Third Quarter 2001*

July brought more closures to many traditional PSP areas of the state as well as some first ever closures in South Puget Sound. In the north, Whatcom, San Juan and Skagit Counties began with partial closures and progressed to all county closures by the end of the month. Central Puget Sound fared only slightly better with closures in North King County and South Snohomish County. The PSP bloom in Kitsap County was so extensive that it closed the entire east side of the county. The South Puget Sound bloom that began at the beginning of June in Carr Inlet expanded in July to include all of Pierce County south of Gig Harbor. The bloom in Thurston County expanded from the Nisqually Reach area to close the entire County, including all of Eld and Totten Inlets for the first time on record. In Mason County, the bloom eventually reached the entire county except Oakland Bay and Hood Canal. This was the first recorded PSP closure for Hammersley and Totten Inlets.

By August, some of the blooms in North Puget Sound had begun to dissipate. Whatcom and Skagit Counties began to lift closures. However, the toxin levels in the San Juan Islands continued to rise. In Central Puget Sound, King County expanded their closure to include Vashon Island. Many sites in Kitsap County also produced more toxic shellfish in August. In Jefferson County, the PSP blooms closed more beaches in the Port Ludlow area, as well as Discovery Bay. The South Puget Sound bloom peaked during the



first week in August. While Pierce County closed its entire shoreline, Mason and Thurston Counties began to lift closure restrictions during August.

September produced one new bloom in Island County, which had been very quiet up until that time. Other parts of the state such as South Puget Sound continued to reflect declining bloom conditions, evidenced by lower toxin test results, which allowed for the lifting of closures.

#### Fourth Quarter 2001

In North Puget Sound, the Island county bloom continued into November, when it peaked at over 1000µg. A new bloom in Whatcom County affecting the Drayton Harbor area, also reached its peak in mid-November. Other late fall blooms occurred in Sequim Bay on the straits, the Port Ludlow area of Jefferson County, North Kitsap County, parts of the San Juan Islands and in Quartermaster Harbor on Vashon Island in Central Puget Sound. All of these late blooms were brief in nature and did not reach very high toxin levels. The rest of the state experienced declining toxin levels during the last quarter of 2001. The highest PSP levels for the year are listed in figure 9.

The Department of Health continued the Sentinel Mussel Monitoring Program as an early warning system for marine biotoxins in 2001. With assistance from local health jurisdictions, tribes, Adopt a Beach, Puget Sound Restoration Fund, and many volunteers, 66 collection sites were maintained

and monitored biweekly to monthly. See the accompanying map (figure 10) for collection site locations used in 2001.

In addition to the sentinel mussel locations, commercial mussels were routinely monitored at the following locations: Westcott Bay, San Juan Island; Penn Cove and Holmes Harbor, Whidbey Island; and Totten Inlet, South Puget Sound.

## **Domoic Acid**

Domoic acid is a naturally occurring toxin produced by species of microscopic marine diatoms of the genus *Pseudonitzschia*. The human illness known as amnesic shellfish poisoning (ASP) or domoic acid poisoning (DAP) is caused by eating fish, shellfish or crab containing the toxin. Symptoms include vomiting, nausea, diarrhea and abdominal cramps within 24 hours of ingestion. In more severe cases, neurological symptoms develop within 48 hours and include headache, dizziness, confusion, disorientation, loss of short-term memory, motor weakness, seizures, profuse respiratory secretions, cardiac arrhythmias, coma and possibly death. There is no antidote for domoic acid poisoning.

ASP was first characterized in 1987 on the Atlantic coast of Canada. Domoic acid was first detected on the Pacific coast in California in the summer of 1991, when a number of pelican



RAZOR  
CLAM



and cormorant deaths were linked to domoic acid in anchovies. In the fall of 1991, domoic acid was detected in razor clams off the coast of Washington. This discovery brought a premature end to the recreational razor clam harvest but not before several mild cases of ASP in humans were associated with the consumption of razor clams.

Domoic acid levels are measured using a laboratory technique called high performance liquid chromatography (HPLC). The level of domoic acid determined to be unsafe for human consumption is 20 ppm in molluscan shellfish and 30 ppm for Dungeness crab viscera. The Dungeness crab areas are closed when three of six individual crab viscera equals or exceeds 30 ppm.

Research shows that razor clams accumulate domoic acid in the edible tissue (foot, siphon and mantle) and are slow to rid themselves of the toxin. In dungeness crab domoic acid primarily accumulates in the viscera.

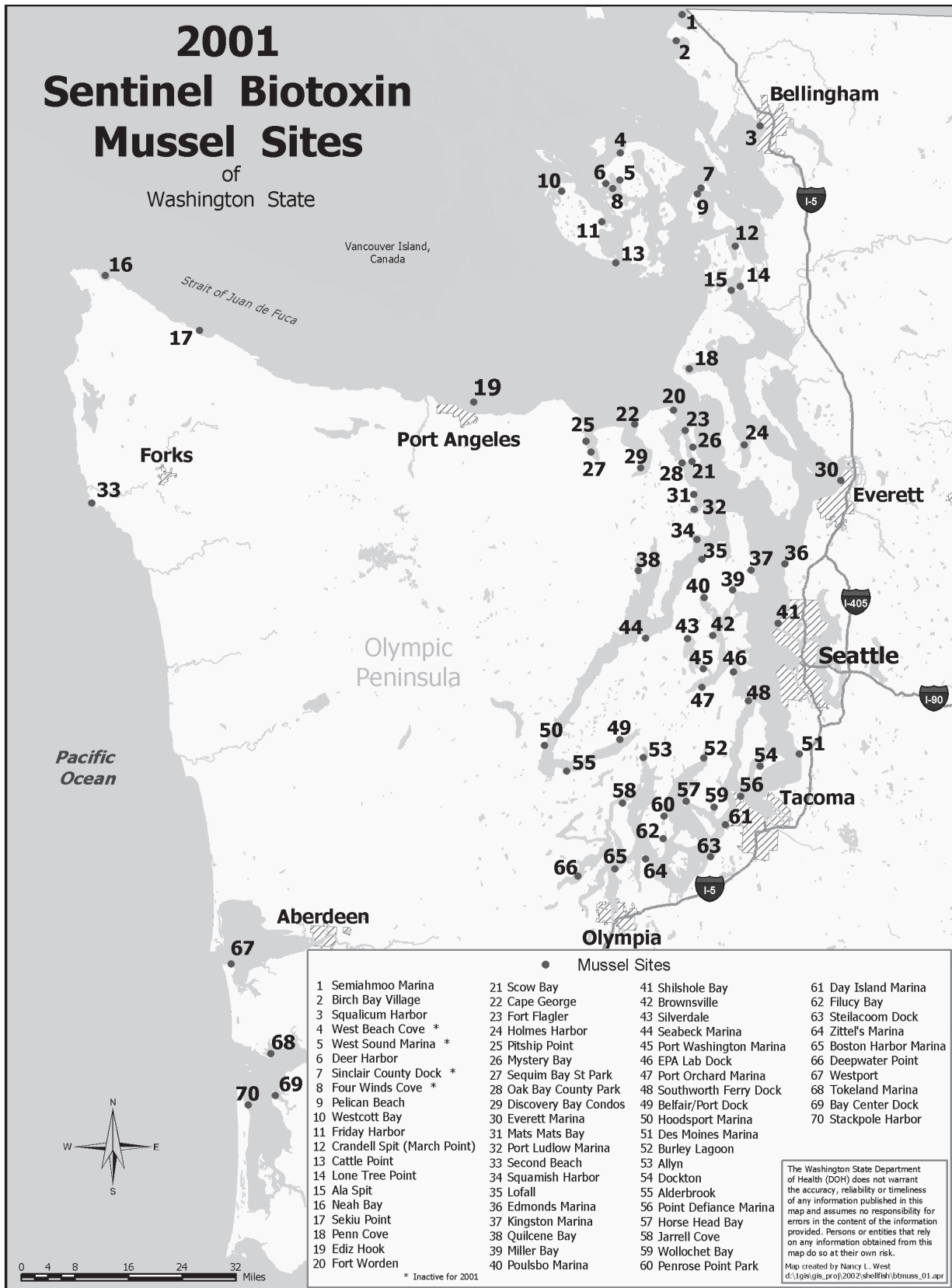
In 1991 DOH began monitoring all major shellfish growing areas for domoic acid. To date, unsafe levels of domoic acid have only been detected in coastal razor clams and dungeness crab. Unsafe levels have not been detected in other species of coastal shellfish, nor has domoic acid been detected in other species in the coastal estuaries of Grays Harbor, Willapa Bay or the inland waters of the Strait of Juan de Fuca, the San Juan Islands or Puget Sound.

*Figure 9. Areas of Highest PSP Levels in 2001*

Date	Harvest Area	Species	Toxin Level*
08/20/01	Kingston Marina	Blue Mussels	1575
08/01/01	Steilacoom Dock	Blue Mussels	1070
08/06/01	Filucy Bay (Pitt Passage)	Blue Mussels	1060
08/13/01	Ediz Hook (Port Angeles Harbor)	Blue Mussels	1048
10/29/01	Holmes Harbor (Whidbey Island)	Blue Mussels	1005
07/14/01	Pelican Beach (Cypress Island)	Blue Mussels	986
08/01/01	Zittel's Marina (Nisqually Reach)	Blue Mussels	943
08/02/01	Stretch Island (Case Inlet)	Geoduck Clams	884
09/13/01	Middle Ground (Sequim Bay)	Butter Clams	796
07/17/01	Ediz Hook (Port Angeles Harbor)	Blue Mussels	751
05/28/01	Penrose Pt. State Park (Carr Inlet)	Blue Mussels	718
06/24/01	Cape George (Discovery Bay)	Butter Clams	714

\* Micrograms per 100 grams of shellfish meat tissue

Figure 10. 2001 Sentinel Biotoxin Mussel Sites



## **2001 Domoic Acid Summary**

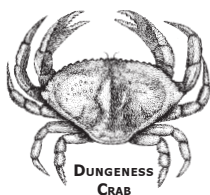
Approximately 30 crab and 1170 molluscan shellfish samples were tested for domoic acid in 2001.

### First Quarter 2001

The year began with low domoic acid levels in razor clams along the outer coast. Samples continued a trend of single digit toxin levels that had begun the previous fall, which allowed for harvesting in January and February. Domoic acid levels in crab remained low as well. March saw a reversal, with toxin levels going up to double digits. The highest toxin levels were at Twin Harbors (24ppm) and Long Beach (22ppm). The bloom also produced results of 1ppm in mussels at Bay Center and Tokeland, inside Willapa Bay.

### Second Quarter 2001

The rise in domoic acid levels in razor clams that began in March reached its peak in April on the outside coast. Fortunately, only Twin Harbors, where a clam sample reached 20ppm, was prevented from having an April opening. The recreational harvests at Long Beach, Copalis, Mocrocks and Kalaloch proceeded as planned. By May, even Twin Harbors had dropped below the action level, allowing for a harvest opening at Twin Harbors, Copalis and Mocrocks. Long Beach did not have a May harvest, as the seasonal harvest allocation had been reached in April.



Kalaloch remained closed in May due to an abundance of very small clams.

In June, commercial razor clam harvesting on the exposed Willapa Spits was interrupted when a sample tested 22ppm. Harvesting resumed in July after toxin levels dropped below the action level and the six-week season was allowed to continue without any additional interruptions.

In the second quarter of the year, there were six Puget Sound shellfish samples with detectable levels of domoic acid. There were two mussel samples and one native littleneck clam sample from Mystery Bay that had a test result of 1ppm of domoic acid. There were three additional shellfish samples with <1ppm of domoic acid. All three were blue mussels taken from Port Orchard Marina in Kitsap County, Fort Flagler in Jefferson County, and the EPA Lab dock at Manchester.

### Third Quarter 2001

In early September, razor clams from Mocrocks and Copalis experienced a sudden elevation in domoic acid levels. The toxin level in the Mocrocks sample reached 52ppm and the Copalis sample peaked at 44ppm. The Olympic Region Harmful Algal Bloom (ORHAB) monitoring effort off Twin Harbors and Long Beach indicated a sharp rise in domoic acid producing algae in August. The sharp rise in toxin levels in the clams followed closely behind the algal bloom spike. It is interesting to note that by the time the clam toxin levels peaked, the plankton population had collapsed to near non-existent. Fortunately, the clam toxin levels also dropped dramatically, leaving the door open for a fall razor clam season.

In the third quarter of the year, there were three Puget Sound samples with detectable levels of domoic acid. They were all blue mussel samples. Mussels at Edmonds Marina in Snohomish County and Zittel's Marina in Thurston County each contained 1ppm of domoic acid. Mussels at Birch Bay Village in Whatcom County contained <1ppm of domoic acid.

#### Fourth Quarter 2001

ORHAB monitoring for the coast continued to show near non-existent levels of domoic acid producing algae for the fourth quarter of 2001. The razor clams continued to drop in toxin as well, with most samples reporting single digit toxin levels. This allowed the recreational harvest of razor clams to continue as planned without any interruptions.

The highest domoic acid levels for the year are listed in figure 11.

For more information on PSP and Domoic Acid contact Frank Cox at (360) 236-3309.

## Summary of PSP Status for PSAMP

Each year DOH analyzes spatial and temporal trends in PSP for the Puget Sound Ambient Monitoring Program (PSAMP). This year, DOH has examined for PSAMP results from 34 selected Sentinel Monitoring Sites for Paralytic Shellfish Poisoning (PSP) toxin in Puget Sound and the straits of Georgia and Juan de Fuca. PSP toxin is measured in mussels collected at each sentinel site. The analysis covers the period from 1991 through 2001.

Figure 12 shows PSP results from 2001 from each Sentinel site sorted into PSP Impact Categories (as defined in the legend). A pie chart summarizes the fraction of results in each category at each Sentinel site. Twenty-four of 34 Sentinel sites had at least minimum PSP impact, compared to 21 reported in last year's Annual Inventory. Three sites with no impact last year were affected this year. They were Penn Cove, North Bay, and Jarrell Cove.

Figure 11. Areas of Highest Domoic Acid Levels in 2001

Date	Harvest Area	Species	Toxin Level*
09/05/01	Mocrocks Area MP	Razor Clam	52
09/05/01	Copalis Area XK	Razor Clam	44
05/01/01	Willapa Spits	Razor Clam	30
03/11/01	Twin Harbors Area CL	Razor Clam	24
03/27/01	Long Beach Reserve	Razor Clam	22
03/11/01	Long Beach Area E	Razor Clam	22
04/22/01	Twin Harbors Area XH	Razor Clam	20
03/05/01	Kalaloch Beach North	Razor clam	17

\* Parts per million

Figure 12. 2001 PSP Sentinel Sites Results

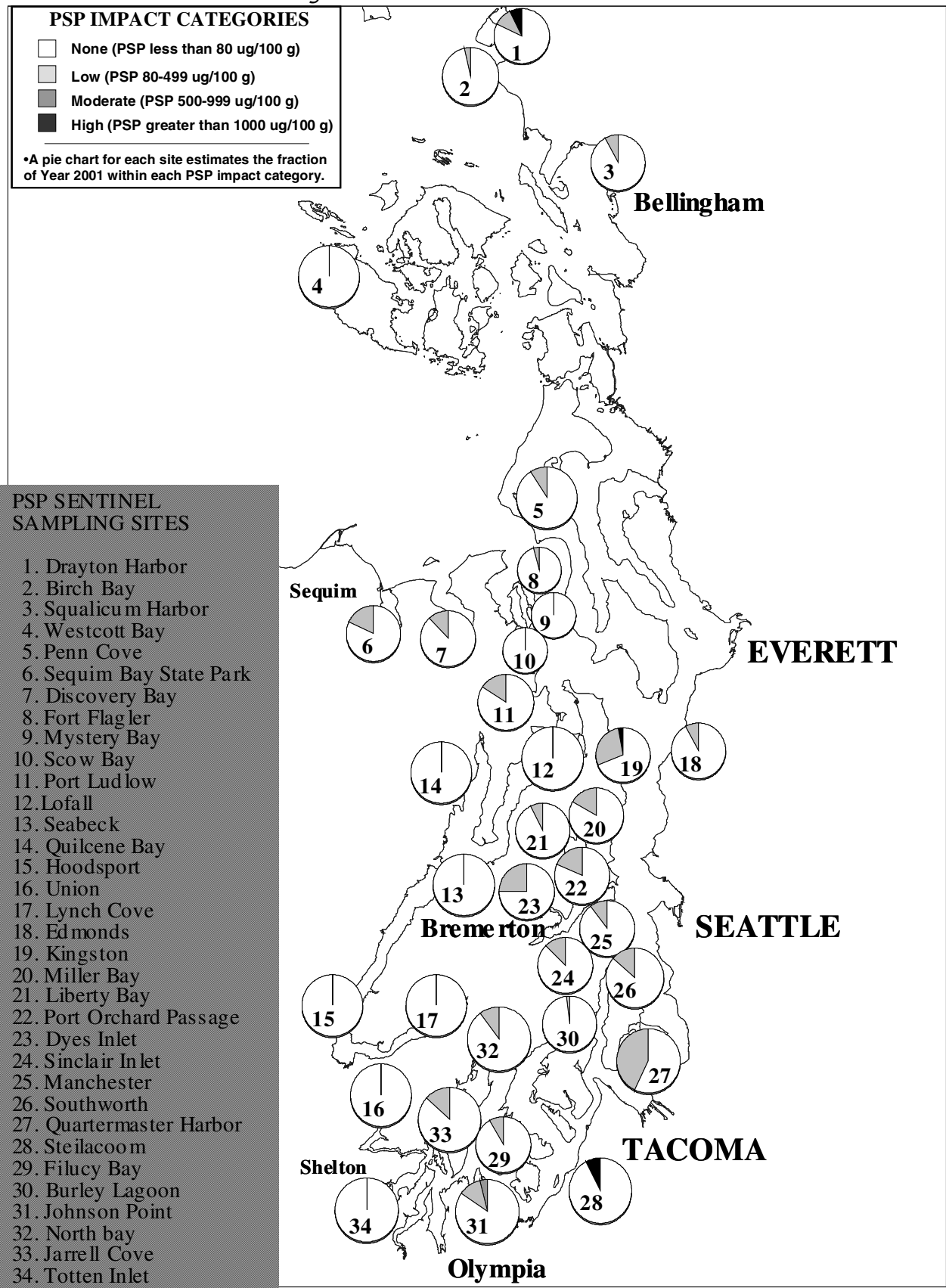
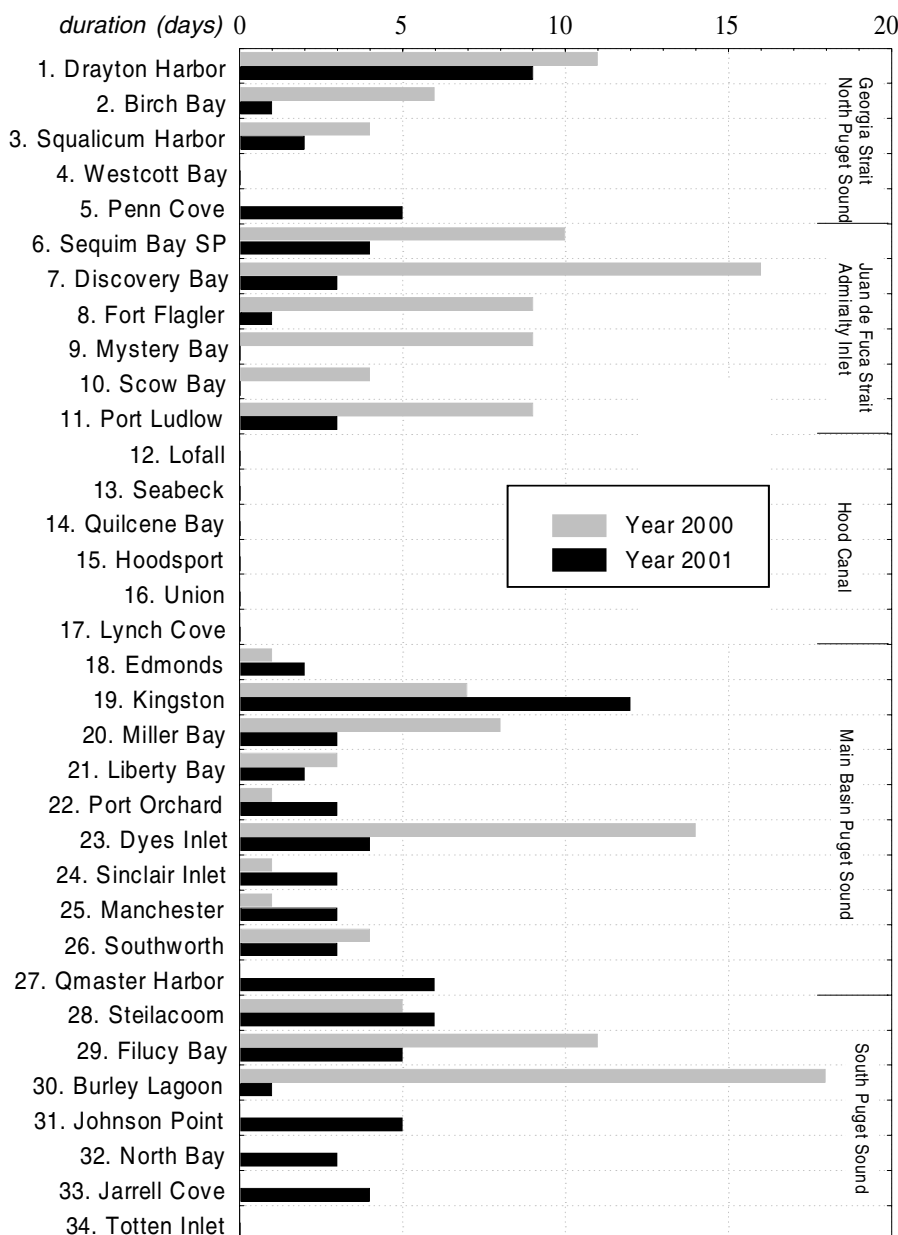


Figure 13 compares PSP impact at Sentinel sites in 2001 and 2000. An "Impact Factor" developed by DOH was used to make between-year comparisons. Fifteen sites were lower this year; 11 were higher. Three of five sites in North Puget Sound and the Strait of Georgia were lower this year. All six Sentinel sites in the Strait of Juan de Fuca and

Admiralty Inlet were lower in 2001 compared to 2000. On the other hand, 10 of 17 Sentinel sites in the Main Basin and South Puget Sound were higher in PSP and 6 sites were lower. Eight sites showed no impact in either year (six sites in Hood Canal, Totten Inlet in south Puget Sound, and Westcott Bay on San Juan Island).

Figure 13. PSP Comparisons for years 2000 and 2001





## **RECREATIONAL SHELLFISH PROGRAM**

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The goal of the Recreational Shellfish Program is to protect the health of recreational harvesters by providing them with sufficient information to make informed decisions about where and when it is safe to harvest shellfish.

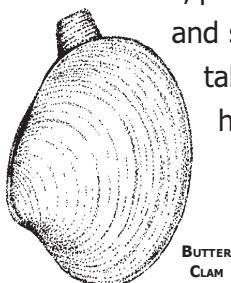
### **Consolidated Contracts**

Local health jurisdictions play an important role in protecting the health of recreational shellfish harvesters. All 12 Puget Sound counties received funding through their consolidated contract with DOH for recreational shellfish activities.

Local participation in biotoxin sampling is a key component of the contracts. The percentage of Puget Sound biotoxin samples collected by local health jurisdictions continues to increase each year and stood at 30% for 2001.

Local health agencies implemented a number of recreational shellfish education and outreach programs through consolidated contracts in 2001. This preventive approach to recreational harvester health promotion is a valuable aspect of the consolidated contracts/ local health partnership. Projects in 2001 included participation in community events and

fairs, partnerships with local schools and state parks, educational talks, outreach to high risk harvester populations, and shellfish telephone hotlines.



**BUTTER  
CLAM**

## **High Risk Harvesters**

High risk harvesters are those harvesting populations who do not have access or an understanding of health information to assure that their shellfish are safe to eat.

Many of the Asian and Pacific Island (API) communities have long been identified as high risk harvesters due to cultural and language barriers. In 2001 DOH continued working on a pilot project with other agencies and API community organizations in Pierce County. Focus remains on communicating health risks for recreational harvesters and how to interpret health warning and regulatory information.

## **Beach Classifications**

Recreational shellfish beaches are classified by DOH as Unclassified, Approved, Conditional, and Closed. Further analysis of harvest on Unclassified beaches will help guide classification and education efforts in 2002.

### **APPROVED**

Approved beaches meet the sanitary standards of water quality and shoreline conditions for shellfish harvest.

### **CONDITIONAL**

Beaches are classified Conditional if they reside within a commercial area with that classification. Conditional beaches close and open based on the same criteria as the commercial area, i.e. rainfall, seasonal marina usage, etc.



## CLOSED

Closed beaches are those that either reside within a Prohibited or Restricted commercial area, or otherwise do not meet sanitary standards for water quality and shoreline conditions for shellfish harvesting.

Other reasons that a beach may be closed include the presence of *Vibrio parahaemolyticus*, sewage treatment plant outfalls, and emergency situations such as an oil spill. DOH supplies signs reflecting situations that may affect public health. Figure 14 shows the recreational harvest signs provided by DOH.

## Web Site Improvements

Work began in 2001 to improve the agency's web site that provides recreational harvesters with health information. The project is expected to be completed by mid 2002.

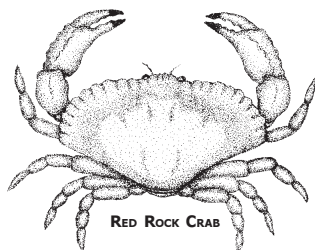


Figure 14. Current Recreational Shellfish Harvest Signs

